

W R C P
S 47

OXFORD LOCAL EXAMINATIONS

SCHOOL CERTIFICATE

THURSDAY, JULY 12, 1945

TIME ALLOWED— $1\frac{3}{4}$ HOURS

Physics II

[Answer any FIVE questions and no more.]

**Illustrate your answers by diagrams wherever these will
make your answers clearer.]**

[Mathematical tables are provided.]

Mechanics

1. State Newton's Laws of Motion.

A wooden block, of mass 5 lb., is pulled along a rough horizontal table by means of a string parallel to the surface of the table, which passes over a light frictionless pulley at the edge of the table and carries a weight of 3 lb. The resistance offered by the surface of the table to the motion of the block is 2 lb. wt. Calculate the acceleration with which the block moves.
($g = 32 \text{ ft./sec./sec.}$)

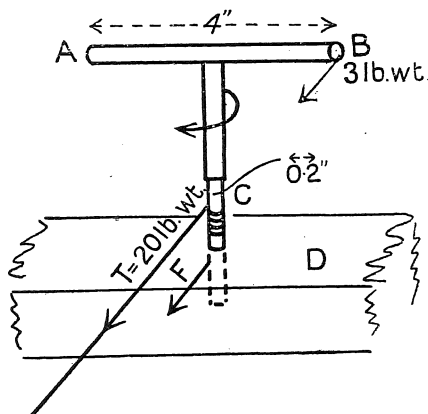
2. Describe the Fortin barometer, and explain how you would proceed to read the value of the atmospheric pressure accurately from it.

An accurate barometer enables the atmospheric pressure to be read to the nearest $1/500$ in. of mercury. What is the smallest change in altitude that can be detected by this barometer?

(Density of air, 0.00129 gm./c.c. ; of mercury, 13.6 gm./c.c.)

3. State the principle of moments, and explain clearly what is meant by the moment of a force.

The diagram represents a piano-tuner's key being



used to tighten a string by turning in the direction of the curved arrow. The arm of the key, AB , is 4 in. long, and

a force of 3 lb. wt. is applied at the end B only, at right angles to AB . The iron cylinder C , round which the string passes, has a diameter of 0.2 in., and is a tight fit in a socket in the board D . The tension T in the string at the moment considered is 20 lb. wt., and the friction between the cylinder and the socket can be regarded as a single force F acting tangentially to the cylinder as shown. If the applied force of 3 lb. wt. is just sufficient to start the key turning, find the value of the force F .

4. Describe an experiment to show that a liquid transmits pressure equally in all directions, and give a brief account of one application of this effect.

The piston of a cycle tyre pump has a radius of $7/22$ in., and the pump barrel is 12 in. long. It is supposed that the pumping stroke starts with the piston at the far end of the barrel, that the tyre valve opens freely as soon as the pressure in the pump barrel equals that in the tyre, and that the volume of the connecting tube is negligible. If the pressure of the atmosphere is 15 lb. wt. per sq. in., and the pressure in the tyre at the beginning of a certain stroke is 26 lb. wt. per sq. in., find (a) the position of the piston when the valve first opens, and (b) the force which must then be exerted by the cyclist on the handle of the pump. (Take π as $22/7$.)

Heat and Light

5. Explain what you understand by the statement, 'The temperature of the room is 16°C .'

Describe, with a careful diagram, a maximum-and-minimum thermometer, and explain the action of the instrument.

6. The *mechanical equivalent of heat* is 778 foot-pounds per *British Thermal Unit*. Explain this statement carefully, defining the terms printed in italics.

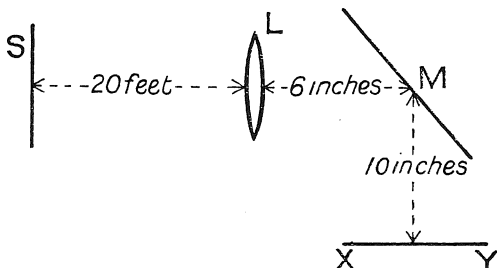
A load of 74 lb. is raised 3 ft. vertically by means of a machine whose efficiency is 22.2 per cent. Assuming that the portion of the work done by the effort that is apparently wasted eventually reappears as heat, calculate the number of B.Th.U. produced.

7. When you look down into a tall beaker of water a mark on the bottom of the beaker appears to be considerably nearer to the surface than it really is. Explain this with the help of a carefully drawn diagram, showing the paths of two rays from one point on the mark. Obtain an equation for the ratio *real depth/apparent depth*.

How would you measure the apparent depth experimentally?

8. What is meant by lateral inversion?

The figure represents in a very simplified form the usual method of projecting pictures of opaque objects



on to a screen. The object XY is strongly illuminated from above; M is a plane mirror, L the projection lens, and S the screen. Explain why the mirror M is necessary, and state whether the top of the object should be at X or at Y , giving your reason.

From the distances indicated in the figure, calculate the focal length of the lens L .

9. You are to suppose that the following instructions have been issued at the beginning of a laboratory practical period:—

‘Set up an object in front of the given concave mirror, and measure the values of the image distance v corresponding to several different values of the object distance u . Plot a graph either of v against u , or of $1/v$ against $1/u$, and determine the value of the radius of curvature of the mirror from your graph.’

Describe with full experimental details how you would carry out the measurements and explain how you would obtain the result from your graph.

How far away from the pole of a concave mirror of radius of curvature 15 cm. must an object be placed in order to give a real image three times magnified?

Magnetism and Electricity

10. What do you understand by the *capacity* of a conductor?

Describe some form of variable-capacity condenser, and explain how you would show experimentally that adjusting it really does produce a change in capacity of the kind intended.

11. Describe the construction of **one** of the following domestic appliances:—

- (a) an electric lamp bulb;
- (b) an electric kettle;
- (c) a modern type of electric fire.

An electric fire has two heating elements *A* and *B*. *A* is rated at 750 watts and *B* at 1,250 watts. In the course of an average winter week the fire is used with *A* alone for 24 hours, and with both *A* and *B* together for 40 hours. Calculate the total consumption of energy during the week in kilowatt-hours, and the cost of running the fire for this period if the charge for electricity is $\frac{3}{4}$ d. per kilowatt-hour.

12. Show on a clear diagram the general arrangement of the magnetic field produced when an electric current flows in a plane circular coil.

Explain the action of the tangent galvanometer, and describe how you would determine the reduction factor of such a galvanometer experimentally.

13. Describe and explain what is observed when an electric current is passed between platinum electrodes immersed in a solution of copper sulphate.

In the figure, *A* is a battery of E.M.F. 3 volts and internal resistance 1 ohm; *B* is a resistance of 1.5 ohm; *C* is a silver voltameter of negligible resistance. Calculate the mass of silver deposited in one hour. (The electrochemical equivalent of silver is 0.001118 gm. per coulomb.)

